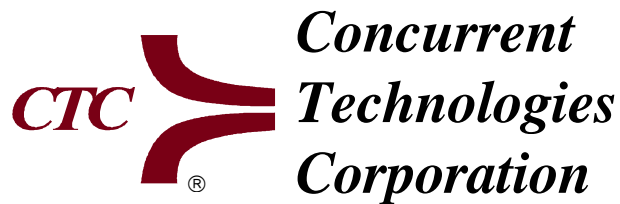


**U.S. Navy Proves Case for Reusable and  
Interoperable Content Developed to the  
Sharable Content Object Reference Model  
(SCORM®):  
Case Study of Systems-Level Oil Spill  
Prevention Training**

**June 16, 2003**



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## 1.0 INTRODUCTION

The U.S. Navy's strategy to reduce oil spills from Navy ships is the product of coalitions established among key Navy activities. One of these coalitions is the Southwest Regional Oil Spill Working Group (ROSWG). Under its initial leadership, Admiral Len Hering, ROSWG envisioned training that would increase both general awareness of oil spill prevention best practices and systems-level expertise for personnel who operate critical oil-carrying systems onboard Navy ships. Working in conjunction with ROSWG to develop this vision are the following individuals and activities:

- Andy Del Collo, R&D Program Manager at Naval Facilities Engineering Command (NAVFAC).
- Walter Rauf, Shipboard Technical Expert, Navy Sea Systems Command (NAVSEA).
- Chief of Naval Operations (CNO), Chief of Naval Education and Training (CNET), now Naval Education and Training Command, and the Environmental Readiness Division.

To answer the need for general awareness of oil spill prevention best practices, a video and Computer Based Training (CBT), designed and developed in conjunction with Concurrent Technologies Corporation (CTC), were introduced to the fleet.

NAVFAC and NAVSEA then took the opportunity to couple the more complex systems-level training with the regular schedule of the fleet's Operational Sequencing System (OSS) updates, taking advantage of interactive technologies to supplement the typical on-the-job learning process.

In addition, the Navy recognized the opportunity to embrace the Department of Defense's (DoD) Advanced Distributed Learning (ADL) Initiative, described as a commitment to "establish a new distributed learning environment that permits the interoperability of learning tools and course content on a global scale"<sup>1</sup>. At the heart of the ADL Vision is a specification for creating "content objects" that can be reused – supported by the Sharable Content Object Reference Model (SCORM®<sup>1</sup>). As one of the active participants in the SCORM, CTC was well situated to assist the Navy in developing the systems-level training to the SCORM. This paper is a case study of the successful design, development and deployment of SCORM (Version 1.2) conformant training by the U.S. Navy.

## 2.0 BACKGROUND

***Note:** Parts of this section contain or are based on material taken from the ADLNet.org Web site ([www.adlnet.org](http://www.adlnet.org)) and the document "Sharable Content Object Reference Model (SCORM) Version 1.2, The SCORM Overview" ©2001 Advanced Distributed Learning.*

### 2.1 The ADL Vision

The DoD and the White House Office of Science and Technology Policy (OSTP) launched the ADL Initiative in 1997. The purpose of the ADL Initiative is to ensure access to high-quality

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<sup>1</sup> SCORM is a registered trademark.

education and training that can be tailored to individual learner needs and made available whenever and wherever it is required.

The ADL Initiative envisions that in reaching the goal of dependable and efficient instruction, training material in the future will:

- Adapt itself to the unique needs, abilities, background, interests, and cognitive style of each learner
- Tailor the content, pace, detail, difficulty, etc., of its presentations as needed
- Be accessible anytime and anywhere
- Be delivered through multiple instructional technologies, including the World Wide Web.

The ADL Initiative envisions the creation of learning “knowledge” libraries – repositories where learning objects may be accumulated and cataloged for broad distribution and use.

In simple terms, this means that learning content (information, exercises, assessments) can be “chunked” in the smallest logical segments possible. Each “chunked” segment is called a Sharable Content Object (SCO). For example, a SCO might contain information on a single topic, an exercise to support it and an assessment to confirm mastery. It may mean any number of other logical arrangements of content as well. The operant point is that the SCO stands alone and may be used in multiple learning environments, and/or be delivered through multiple delivery systems. A series of SCOs can be chosen by instructional designers, in a “cafeteria” process and aggregated to make new courses.

## **2.2 The ADL Co-Labs**

In 1999, the DoD established the Alexandria ADL Co-Laboratory (Alexandria ADL Co-Lab) in Alexandria, Virginia to foster the collaborative research, development, and assessment of the common tools, standards, content, and guidelines for the ADL Initiative.

To support specific ADL communities, two other ADL Co-Labs<sup>2</sup> were established:

- **Joint ADL Co-Lab** (Orlando, Florida) - to facilitate the implementation of ADL across the DoD.
- **Academic ADL Co-Lab** (Madison, WI) - to be the nation's focal point for academia in distributed learning.

All three ADL Co-Labs work together to share research, subject-matter expertise, common tools and course content.

## **2.3 The Sharable Content Object Reference Model (SCORM)**

The SCORM is intended to provide the technical means for content objects (SCOs) to be easily shared across multiple learning delivery environments.

ADL's high-level requirements for content objects are as follows:

- **Accessibility** – The ability to access instructional components from one remote location and deliver them to many other locations
- **Interoperability** – The ability to use instructional components developed in one location with one set of tools or platform in another location with a different set of tools or platform
- **Durability** – The ability to withstand technology changes without requiring redesign or recoding
- **Reusability** – The flexibility to incorporate instructional components in multiple applications

Procedures for developing such content objects are state-of-the-art, but they must be articulated, accepted, and widely used as guidelines by developers and their customers. These goals can only be achieved through collaborative development. Such collaboration requires agreement upon a common reference model. The SCORM is intended to be such a model.

Learning Management Systems (LMSs) serve a key function – the management of content objects. An LMS is a suite of functionalities designed to deliver, track, report and manage learning content, as well as user progress and user interactions. The SCORM supports the notion of learning content composed from relatively small, reusable content objects (SCOs) aggregated together to form units of instruction. By themselves, content objects have no specific context. Once combined with other content objects, an LMS manages the learning experience, including sequencing the SCOs, providing navigation between them and establishing context.

### **3.0 SYSTEMS-LEVEL OIL SPILL PREVENTION TRAINING DEVELOPMENT PROCESS**

In response to Navy initiatives, training to reduce oil spills was designed and developed for personnel who operate critical oil-carrying systems onboard Navy ships. Drawing upon experience gained in developing video and CD-ROM training for oil spill prevention awareness, CTC and Navy subject matter experts (SMEs) collaborated to create content for eight oil-carrying systems for each of two ship classes.

Discussions early in the project addressed the challenge of creating cost-effective training for all of the Navy's ships. Initial thinking was to develop hull-specific content, but the prohibitive cost of such a plan led to the ship class level approach. To further economize, and in support of DoD's ADL Initiative, CTC proposed the concept of identifying systems that are similar enough for content to be shared across ship classes. Following this logic, CTC created the framework for a systems matrix. The Navy carried out an analysis and populated the matrix, showing similar systems among ship classes.

#### **3.1 Guide to the Matrix**

The NAVSEA ship class matrix shown in Figure 1 lists ship classes down the left side and the eight oil-carrying systems across the top. Each cell of the matrix represents a lesson developed

for one of the eight systems – the combination of a color and an acronym identifies a single lesson. An empty cell indicates that this particular ship class does not contain the designated oil-carrying system, and therefore no training content is required.

For example, in the column titled “Fuel Oil Fill and Transfer,” note that most rows show unique colors, but in three cases there are cells that share a color. In ship classes CV-63/64 and CV-67, the fuel oil fill and transfer systems are both colored light blue. This indicates that Navy SMEs determined the fuel oil fill and transfer systems in these two ship classes are similar enough that training content could be shared. As another example in the column titled “Aviation Fuel Oil Fill and Transfer,” note that four ship classes (LHA-1, LHA-2, LHD-1 and LHD-7) are similar enough to make it possible to share material. If all the courses represented by the matrix were developed, 22% of the training would be SCOs reused in multiple courses.

Ship Class	Oil-Carrying Systems (Lessons)							
	Fuel Oil Fill and Transfer (FOFT)	Fuel Oil Service (FOS)	Lube Oil Fill and Transfer (LOFT)	Lube Oil Service (LOS)	Aviation Fuel Fill and Transfer (AFFT)	Aviation Fuel Service (AFS)	Oily Waste Transfer and Storage (OWTS)	Main Drainage (MD)
DDG-51	FOFT	FOS	LOFT	LOS	AFFT	AFS	OWTS	MD
CG-47	FOFT	FOS	LOFT	LOS	AFFT	AFS	OWTS	MD
FFG-7	FOFT	FOS	LOFT	LOS	AFFT	AFS	OWTS	MD
CV-63/64	FOFT	FOS	LOFT	LOS	AFFT	AFS	OWTS	MD
CV-67	FOFT	FOS	LOFT	LOS	AFFT	AFS	OWTS	MD
CVN-65					AFFT	AFS		MD
CVN-68					AFFT	AFS		MD
LSD-41	FOFT	FOS	LOFT	LOS	AFFT	AFS	OWTS	MD
LSD-49	FOFT	FOS	LOFT	LOS	AFFT	AFS	OWTS	MD
LHA-1	FOFT	FOS	LOFT	LOS	AFFT	AFS	OWTS	MD
LHA-2	FOFT	FOS	LOFT	LOS	AFFT	AFS	OWTS	MD
LHD-1	FOFT	FOS	LOFT	LOS	AFFT	AFS	OWTS	MD
LHD-7	FOFT	FOS	LOFT	LOS	AFFT	AFS	OWTS	MD
LCC-19/20	FOFT	FOS	LOFT	LOS			OWTS	MD
AOE-1	FOFT	FOS	LOFT	LOS			OWTS	MD
AS-39/40	FOFT	FOS	LOFT	LOS			OWTS	MD
ARS-50	FOFT	FOS	LOFT	LOS			OWTS	MD
AGF-3/11	FOFT	FOS	LOFT	LOS	AFFT	AFS	OWTS	MD
LPD-4	FOFT	FOS	LOFT	LOS	AFFT	AFS	OWTS	MD
MHC-51	FOFT	FOS	LOFT				OWTS	MD
MCM-1	FOFT	FOS	LOFT	LOS			OWTS	MD
PC-1	FOFT	FOS					OWTS	MD

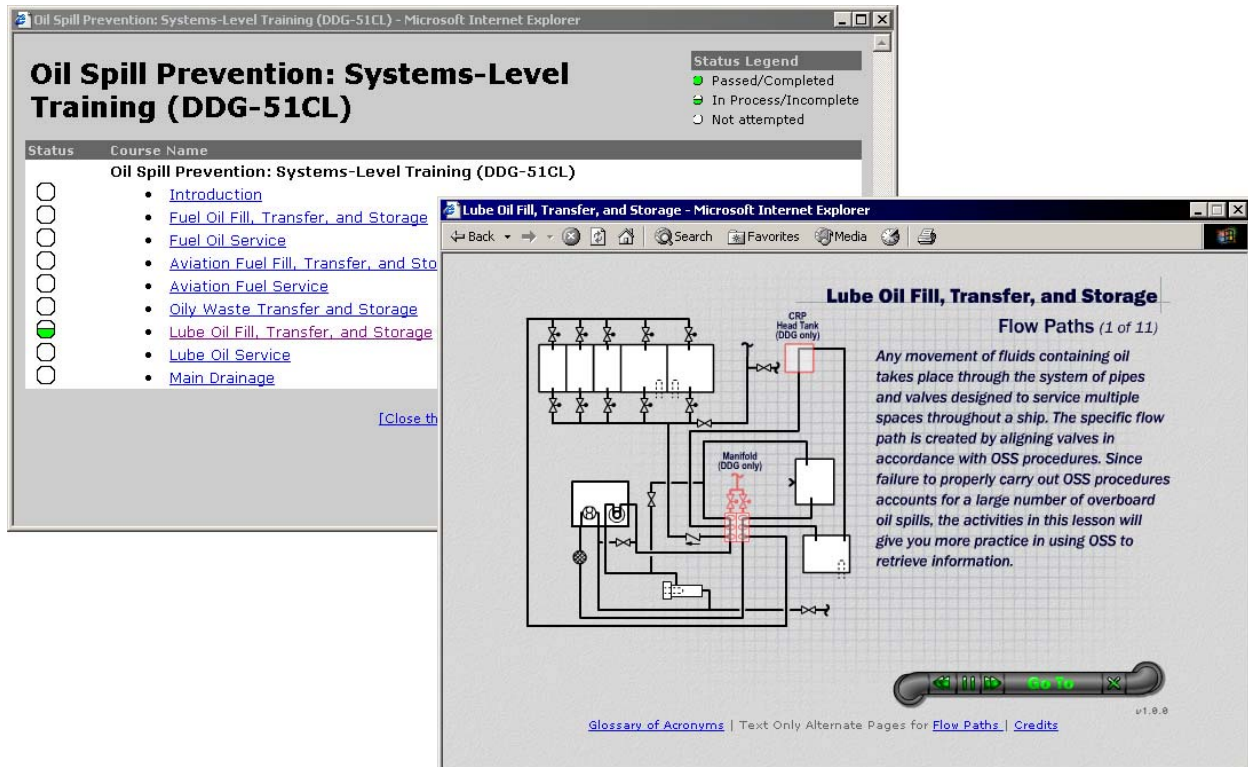
**Figure 1: NAVSEA Ship Class Matrix**

### 3.2 Reusable Content

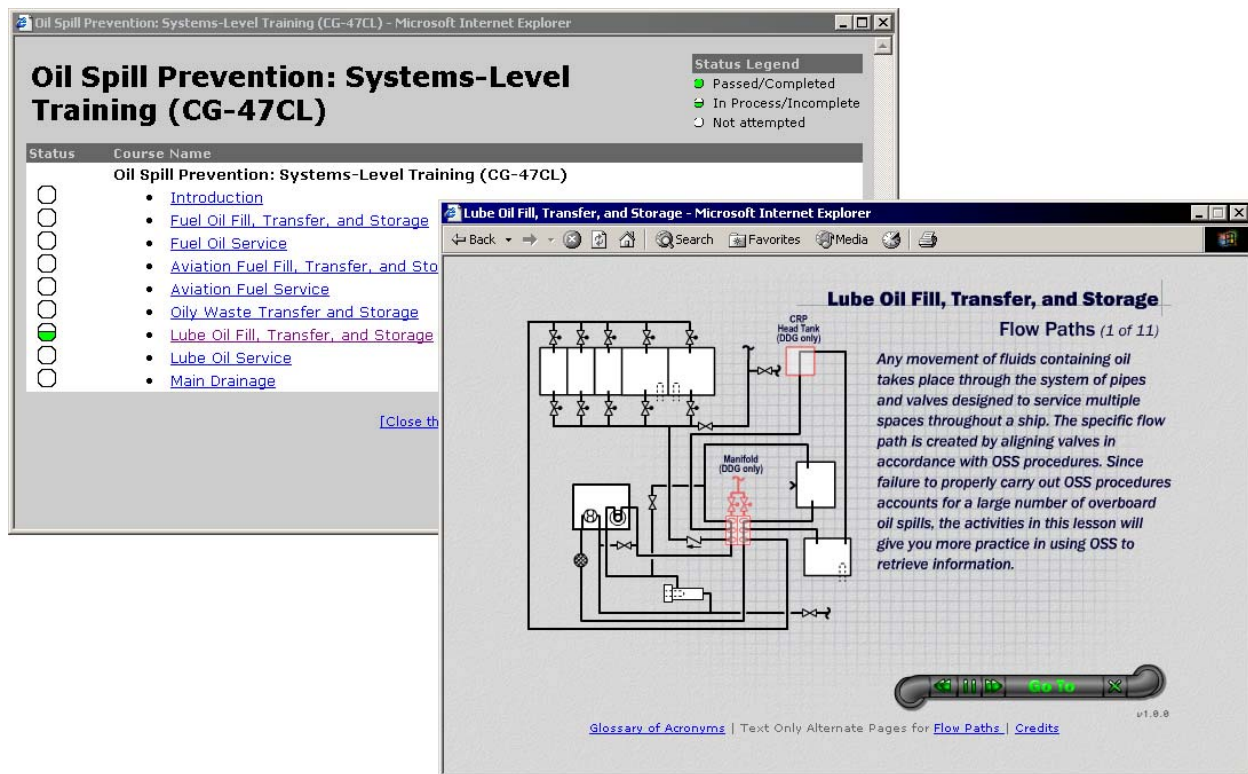
Based on the NAVSEA matrix, a “library” of lessons for two ship classes (DDG-51 and CG-47) and their corresponding oil-carrying systems was developed in the first phase of this project. Each lesson is an individual SCO. These SCOs were combined into complete courses – one course for DDG-51 and another for CG-47. To provide context for the context-neutral SCOs, an introductory lesson for each course was also developed.

The NAVSEA matrix identified one oil-carrying system (Lube Oil Fill and Transfer) similar enough between DDG-51 and CG-47 that a lesson could be shared between the two systems. True reuse of the training material became possible. The only difference in the presentation of the content is the LMS course identification associated with each, providing context.

Figure 2 shows the SCO for Lube Oil Fill and Transfer presented as a lesson in the DDG-51 course. Course identification, along with SCO navigation and status, appears in the LMS window. Figure 3 shows the identical content reused as a lesson in the CG-47 course.



**Figure 2: Reusable Content from the Lube Oil Fill and Transfer Lesson Presented in the DDG-51 Course**

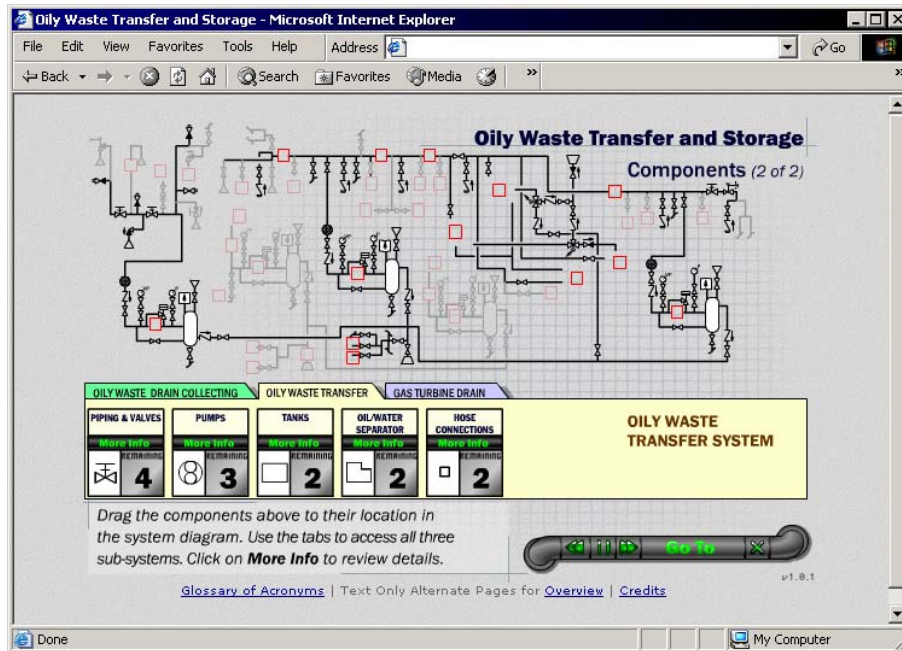


**Figure 3: Identical Content from the Lube Oil Fill and Transfer Lesson Reused in the CG-47 Course**

### 3.3 Interoperable Content

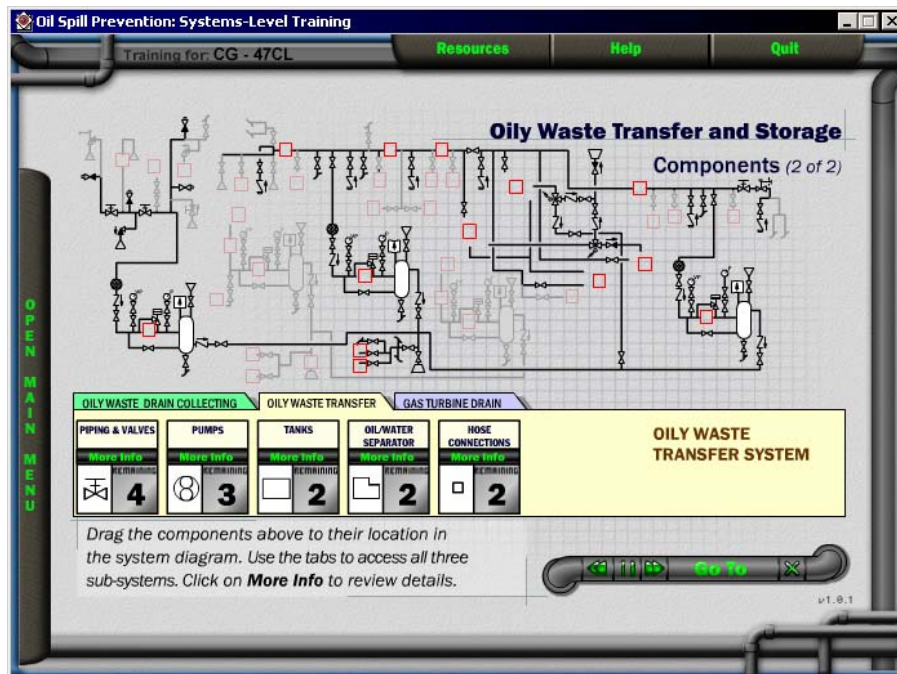
Due to a lack of consistent and high speed Internet access, U.S. Navy ships currently require the delivery and management of computer-based training from standalone workstations. However, Navy schools onshore require the same training to be delivered online through the Navy's E-Learning Web portal. To achieve interoperability of the material, CTC used a development process that supports dual deployment: reusable content that works in both Web-based and CD-ROM delivery environments.

The Web-based version runs on an LMS, such as Navy E-Learning, which is built upon the THINQ Learning Solutions LMS product. The LMS provides sophisticated knowledge management capabilities. In Figure 4, the user's Web browser is clearly visible at the top of the screen, and resources (assets) are linked at the bottom of the screen. The LMS provides the support for user registration, login, lesson selection, lesson completion tracking and help with using the LMS.



**Figure 4: Interoperable Training Disseminated via the Web**

The CD-ROM version, shown in Figure 5, uses a software “shell” to house the same lesson content. This shell mimics an LMS by managing all the SCOs and allowing for some basic tracking of progress. The shell consists of the course identification at the top left, (“Training for CG-47CL”), access to “Resources,” “Help” and “Quit” along the top right, and the retractable menu panel on the left side.



**Figure 5: Interoperable Training Disseminated via the CD-ROM**

### 3.4 Course Content Menus

Following initial logon, users choose a course and navigate to associated lessons from a menu. Figure 6 shows the menu of training content in the LMS environment allowing navigation between SCOs. Figure 7 shows the same function handled by the software shell when the training material is in the CD-ROM environment.

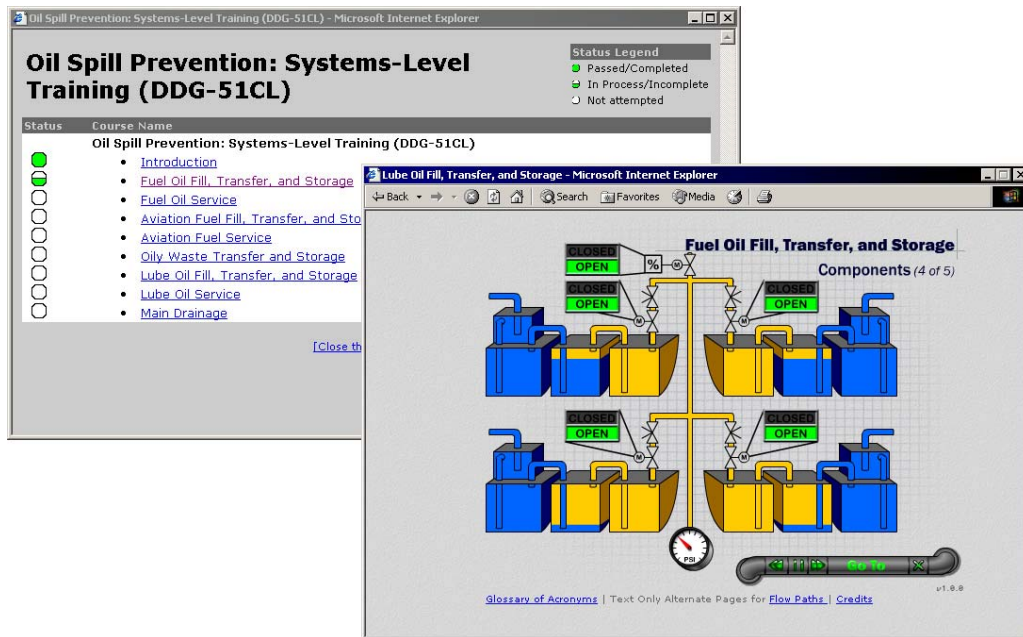


Figure 6: Course SCO Navigation in the LMS Environment

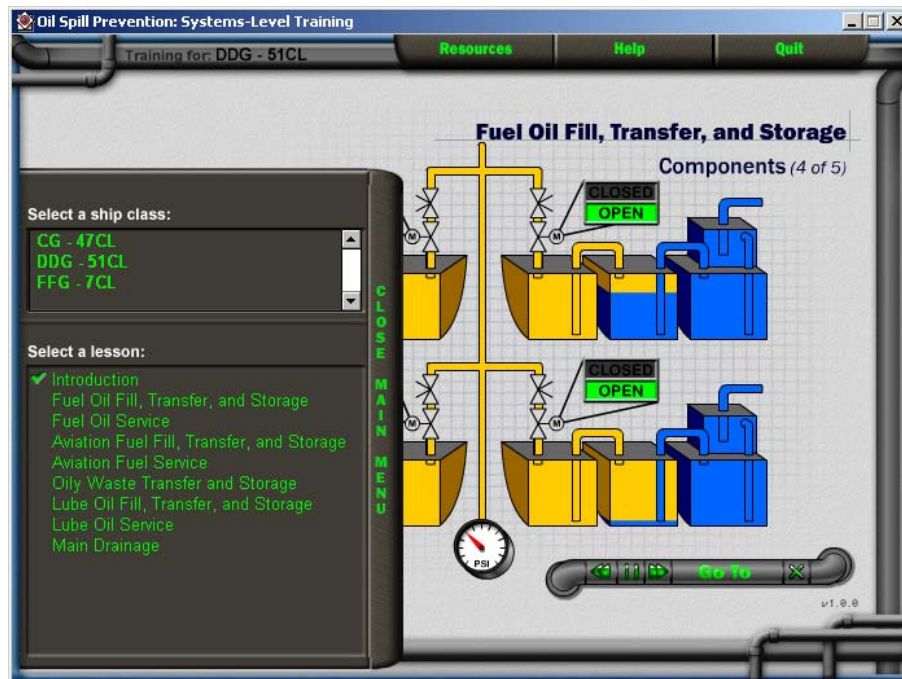


Figure 7: Course SCO Navigation in the CD-ROM Environment

## 4.0 LESSONS LEARNED

Implementation of training based on SCORM is in its infancy. This project provided an opportunity to capture lessons learned in the course of designing and developing reusable and interoperable training content under SCORM Version 1.2. Standard approaches to instructional and technical design required adaptation as new factors influenced decisions. For example, knowing that individual lessons (each one a SCO) might be “lifted” and used in other courses prohibited linking them logically with references to “what you studied in the last lesson” or “what you will see in the upcoming lesson.” In addition, not knowing the order in which a user might choose to study each SCO, it was not possible to “build” upon concepts or facts introduced in other lessons. This non-linear mindset became the norm for designers working on this project.

Other lessons learned (CTC 2003) include the following:

- Development of SCORM conformant content has the most promise for reusability in a fairly closed community of users in which the following circumstances exist:
  - Users whose profile can be accurately and consistently drawn, such as colleges, hospitals or military organizations.
  - Training needs that can be predicted over a relatively long span of time.
  - A SCORM conformant LMS as the preferred, or only, delivery method.
  - A look and feel for the SCOs that can be standardized, minimizing the distraction for the user and the loss of consistency bound to occur when SCOs from disparate training pieces are combined in new arrangements.
  - Content that is broad enough to be applicable to more than a small community of users.
  - Content that will not age rapidly or become irrelevant by the time anyone would want to reuse it.
  - Content that is not specific to one group, location or timeframe.
  - Content that is likely to be relatively standalone vs. content that is context-dependent.
- The size of a SCO must be defined in the initial design phase. In this project the NAVSEA matrix determined sharable material and therefore, the size of a SCO.
- Cost savings on SCORM conformant content occurs in the development phase, not in analysis.
  - During the analysis phase, determining sharable content requires detailed comparisons and input from SMEs to assure that it can be effectively and accurately reused.
- Providing context-specific training is possible without “contaminating” the context-neutral content.
  - An introductory, context-specific SCO was developed for each course, establishing the context for an otherwise context-neutral group of SCOs.
  - The context-specific introductory SCO was linked by the delivery system to its appropriate context-neutral group of SCOs.
- Minimal requirements for data capture, including user profiling and assessment data, support maximum interoperability while the SCORM specification is maturing and being more widely adopted.
  - Capture of user data, such as profile, lessons completed, etc. must be supported by the LMS.

- There is currently no guarantee that any particular LMS will be fully able to support all desired data capture.
- Interoperability has been successfully demonstrated on multiple LMS products including THINQ, Saba™, and others.

## 5.0 CONCLUSIONS

The Navy's Systems-Level Oil Spill Prevention Training is a showcase for the successful achievement of several goals of the ADL Initiative:

- Identification of specific material with the potential to be shared (facilitated in this case by the NAVSEA matrix)
- Use of SCORM as the guideline for development
- Creation of truly reusable and interoperable SCOs
- Proven interoperability (CD-ROM and Web-based versions)
- Collaborative effort between the customer and the development community.

The Navy can realize the full benefit, including cost savings, of the 22% sharable content represented in the NAVSEA matrix in future development of systems-level training. This would continue to support the case for the SCORM standard and implementation of the DoD's ADL Initiative.

As the SCORM development community undertakes more projects, lessons learned will provide the foundation for establishing best practices. These best practices will contribute to instructional design and technical guidelines, which will support the ADL goals and promote successful adoption of the SCORM.

To submit questions regarding the Systems-Level Oil Spill Prevention Case Study, please visit the Help & Info Center at [www.adlnet.org](http://www.adlnet.org).

## **APPENDIX A - FOOTNOTES**

<sup>2</sup>ADLNet.org Web site (<http://www.adlnet.org>)

<sup>3</sup>ADL Co-Labs

- Alexandria ADL Co-Lab - Alexandria, VA  
(<http://www.adlnet.org/index.cfm?fuseaction=ADLCo-La>)
- Academic ADL Co-Lab - Madison, WI  
(<http://www.adlnet.org/index.cfm?fuseaction=colabacd>)
- Joint ADL Co-Lab - Orlando, FL  
(<http://www.adlnet.org/index.cfm?fuseaction=colabjnt>)

## **APPENDIX B - REFERENCES**

Advanced Distributed Learning ©2001. “Sharable Content Object Reference Model (SCORM) Version 1.2, The SCORM Overview”

Concurrent Technologies Corporation (CTC) 2003. “Systems-Level Oil Spill Prevention Training: SCORM /ADL Lessons Learned and Observations”